Research Proposal

"Design of effective techniques for prevention and detection of grape diseases at real time using IoT and Image Processing"

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1. Title of the research proposal

"Design of effective techniques for prevention and detection of grape diseases at real time using IoT and Image Processing"

2. Introduction

Agriculture is one of the primary occupations of man since early civilizations. Even today, manual intervention is inevitable. Around sixty to seventy percent of the population depends on the resources from the agricultural sector. This sector is evolving with the advent of the information and communication technology which is playing its role in bringing the change. Efforts are being made to enhance the productivity and reduce losses by using the state of the art technology and equipment.One such technology such as Internet of Things [4] can result into cheap yet effective methods of agriculture, which in turn will surely give rise to higher quality production.

Irrigation/Water stress, Fertilizers, pesticides and quality of yield, disease monitoring and detection are the major factors of concern in agriculture[2]. Most of the time the expertise are required to analyze the problems which may be time consuming and costlier issue in developing countries. Image processing is one of the tools which can be applied to measure the parameters related to agronomy with accuracy and economy.
At other instances, real-time data about soil, air quality, water levels etc. can help farmers in making a much informed decision about planting and harvesting crops [3], thereby increasing the overall yield of the crops.

Grape cultivation has social and economic importance in India. Maharashtra ranks first in grapes production. Over the last few years the quality of grapes has degraded because of many reasons. One of the important causes is diseases on grapes. To prevent diseases farmers spray huge amount of pesticides, which have harmful effects on plants in addition to the human being. Further, farmers are unable to identify the diseases manually. The diseases are identified only after the infection and have adverse effects on vineyard**[1]**.Grapes are a crop that is susceptible to many diseases. The important grape diseases are anthracnose, downy mildew, powdery mildew and bacterial leaf spot, mealy bug, black rot and many more. It is recommended that vineyards be systematically

inspected throughout the growing season to monitor the appearance and development of diseases. Rapid and accurate identification of diseses in the vineyard is key to preventing serious outbreaks and losses in yield and quality.

Another disadvantage is that grapes may carry toxins[6]. To reduce cost of production and enhance the quality and quantity of the grapes, it is important to propose some mechanism that will help the farmer to detect the disease in early stage.

The trending and future technologies like IOT, digital image processing alongside sensor networks has demonstrated their evitable accomplishment in different applications individually, but the combination of these is so far non-existent.

We propose an expert system based on the Internet of Things (IoT) to collect and monitor real time data. To further detect the grape leaf diseases, an image processing based approach will be used.This will help to take proactive and preventive actions.

The objective is to detect, identify, accurately quantify and prevent disease to occur in order to minimize the losses and increase the economical profit.

3. Literature survey

The important grape diseases are anthracnose, downy mildew, powdery mildew and bacterial leaf spot. In recent years, Alternaria is also becoming a serious pathogen [7].

Powdery mildew can be identified by visualizing white powdery like spots on stems, leaves and the cluster. It spreads in dry as well as wet conditions. Downy mildew shows yellow to brownish spot on the leaves. Downy is very hazardous, once spread it is difficult to control it. It damages the grape yard in a short period of time. Anthracnose is prevalent in all grape growing regions of the country. The disease is characterized by small light brown or greyish black lesions on tender shoots, young leaves, flowers and young berries.Bacteria infects leaves, shoots and berries. The symptoms appear as minute water soaked spots on the lower surface of the leaves, especially along the main and lateral veins. Mostly these spots coalesce and form larger patches. Alternaria attacks both leaves and fruits. Small yellowish spots first appear along the leaf margins, which gradually enlarge and turn into brownish patches with concentric rings. Severe infection leads to drying and defoliation of leaves.

Camargo and Smith[8] proposed a method to identify regions of leaves containing lesions caused by diseases. The tests were performed using leaves from a variety of plants, like bananas, maize, alfalfa, cotton and soybean. Their algorithm is based on two main operations. First, a color transformation to the HSV and I1I2I3 spaces is performed, from which only H and two modified versions of I3 are used in the subsequent steps. The transformed image is then segmented by analyzing the distribution of intensities in a histogram. This techniques is particularly useful when target in the image data set is one with a large distribution of intensities.

Z. B. Husin et al developed quick and correct method in which the chili leaf diseases are detected using color clustering method[9]. This technique ensures that the chemicals only be applied when the lants are detected to be affected with the diseases. Kim et.al[10], used color texture features analysis to classify the grape fruit peel diseases. The texture features are calculated from the SGDM and squared distance technique is used for the classification. Color and textures features are extracted and categorization is done using neural networks[11]. However, the abov technique results in the low recognition rate of the diseases. Wayne Wilcox [12] presented grape disease control thesis and different fungicides for respected diseases. The author states that there are no mixtures(with the possible exception of Tanos) , price competitive funcgicide that provdes control of downy mildew.

Agrisense system [3] detect downy mildew by collecting weather information and applying semi-empirical model which provdes the portable information of downy mildew. They implemented this system for Sula Vineyard in Nasik, Maharashtra but it is not useful for farmers.

Narvear and Patil[4] offered novel algorithms which were based on imageprocessing for grape leaf diseases detection. Drawback of the proposed system is that they do not apply segmentation, resulting into poor classification of powdery mildew and downey mildew.

Chen and Jin [13] proposed the ‘Digital Agriculture’ based upon IoT. The working of the digital agriculture is divided into two steps: in the first phase, the information about the temperature, the wind, the soil contents are collected by different sensors. In the second phase, ZigBee transfers information to the gateway. Finally, the gateway controls the

switch unit to water, fertilize, ventilate and control temperature automatically with the support of the application servers. Chen suggest using IoT for effective exploitation of the agricultural resources, reduction in production costs, improving the ecological environment and the quality detection of the agricultural products.

Ji-Chun Zhao et al. [14] studied the applications of IoT in agriculture. They offered a monitoring system based on internet and wireless sensor networks. An information management system was designed to provide the data for research in agriculture. Software for monitoring of the fields like data acquisition about the fields, data processing models, and system configuration module is developed. This application provides accurate control for the monitoring of the green house. However, the system works offline.

4. Statement of Problem

Although significant progress of disease detection techniques are implemented in the past, very few researchers have addressed the issue for **early detection of downy/powdery mildew and other fungicide diseases.** Current work also does not identify **more than one disease at various stages in its development.** Furthermore, the most successful work till date has **not been on in-field images**. Our proposed research work **on early stage** (before Inflorescences and the berry stage) **disease detection by capturing various parameters using Internet of Things and further analysising it using Image Processing tools**. This system will resolve the problem of identifying and controlling several disases at real time.

Main objective of this proposal is described by the statement of the problem, expressed as follows:

"Design of effective techniques for prevention and detection of grape diseases at real time using IoT and Image Processing"

The proposed research work can be divided into following steps:

1. To propose the cost effective solution to capture the images of the grapes and leaves using drone camera.
2. To design an efficient algorithm for leaf extraction based on image processing.

3. To develop a proficient leaf disease segmentation algorithm.
4. To introduce an innovative algorithm to recognize various grape diseases.
5. To propose an IoT mechanism to alert the farmer, regarding the status of disease occurrence and offer a novel pest sprinkling method to control the effect of disease.

5. Proposed scheme

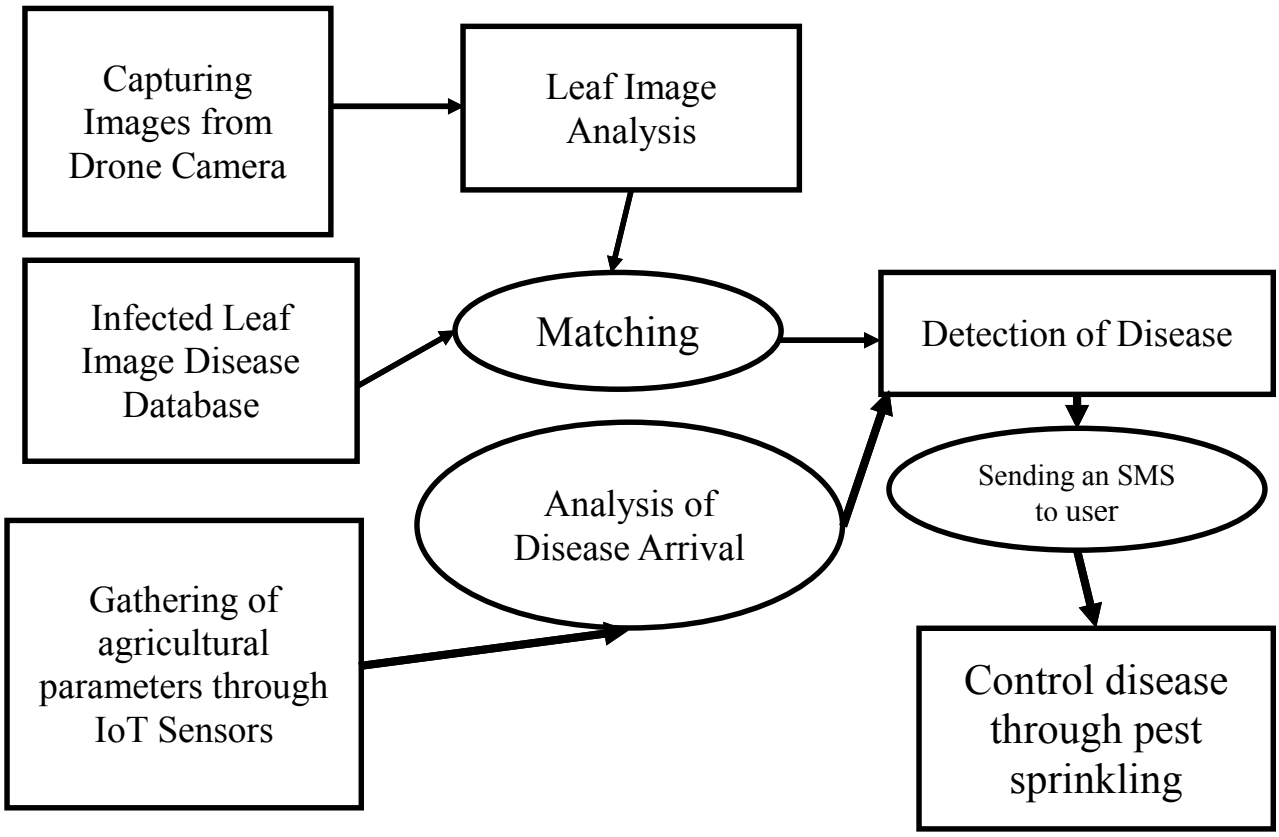
Capturing Images from Drone Camera
Leaf Image Analysis
Infected Leaf Image Disease Database
Matching
Detection of Disease
Sending an SMS to user
Analysis of Disease Arrival
Gathering of agricultural parameters through IoT Sensors
Control disease through pest sprinkling

Fig. 1 : Proposed System Architecture

Figure 1 shows proposed system architecture. Here,the camera sensors placed on drone will capture the images of grapes and its leaf as it moves in the prescribed route (identified using routing algorithm). All the captured images are further analyzed using leaf segmentation algorithm.Thereafter, the detection of the various disease such as Downy/Powdery Mildew will be done by comparing the Leaf Database containing the sample infected images of the various diseases. As soon as the disease is detected an SMS

Notification of the type of disease along with the location will be sent to user. For the prevention, IoT sensiors will continuously gather the agricultural parameters such as soil, moisture contents, temperature, humidity etc. The next step will be to analyze them for early symtoms of disease arrival and the inform the farmer through SMS about the same.

According to the notification received the farmer sends the drone filled with the appropriate pesticide which will again route to the desired location as obtained in the SMS and sprinkle it on the infected grape or leaf.

6. Implementation

Python programming and MATLAB with Image Processing Tool box can be used to implement this proposed work along with Raspberry pi.

A tentative time schedule of the research work planned is given below

Sr.no	Research activity	Schedule
1.	Further detailed literature survey	6 months
2.	Capturing images and gathering real time agicultural data using IoT sensors.	2 Month
3.	Design of an efficient algorithm for leaf extraction and leaf disease segmentation	6 Months
4.	Develop a proficient algorithm to analyze the agricultural data.	6 Months
5.	Introduce an innovative algorithm to recognize various grape diseases.	6 Months
6.	Propose a mechanism to alert the farmer, regarding the status of disease occurrence and offer a novel pest sprinkling method to control the effect of disease.	2 Months
7.	Performance Evaluation	2 Months
8.	Thesis write-up, revision and correction	6 Months

7. Conclusion

In the agricultural sector, emergence and development of plant diseases as well as pest outbrteaks has become more common nowadays. The rate of disease extent depends on current crop conditions and susceptibility to infecton. Grape

farming in India faces a serious threat from leaf diseases. The major diseases include downy mildew, powdery mildew and anthracnose, which cause enormous economic losses to grape sector evey year. Rapid and accurate identification of these diseases in the vineyard is thus a key to prevent serious outbreaks and losses in yield and quality.

The proposed system will use IoT to capture the images of grape leaves using the camera sensor placed on drone. Further, the agricutltural parameters like soil, moisture contents, temperature, and humidity etc. will be gathered by respective sensors. Image processing works as a tool to detect the diseases of grape plant i.e. downy mildew, powdery mildew and anthracnose etc. To manage these diseases it is mportant to control it before it is completely developed. Therefore, as soon as the diseases are detected a message alert is passed to the user. Thereafter, the user fills respective pesticide in a drone that sprays it automatically on infected leaves. This research work furthermore focuses on multiple grape diseases identification at the early stage of its development. The resulting agricultural automation system will help and reduce the rigorous efforts taken by user to consistently monitor and manage the different grape leaf diseases.

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Research Scholar	Research Guide
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